



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

SEX RATIOS IN DROSOPHILA AMPELOPHILA.

ELIZABETH RAWLS,

COLUMBIA UNIVERSITY.

As a rule there is an excess of females amongst the fruit flies that first hatch. It seemed that this must be due to the more rapid development of the females since the total output gives approximately an equal number of males and females. It was possible, although improbable, that more females are actually *produced* at first and more males later. In order to test this possibility five pairs of wild flies from stock that had been a year in confinement were placed in bottles and after two days removed to new bottles. Then after two days each pair was removed to a third bottle, etc., as long as the pair lived. Counts were made of all the flies produced in each bottle. The results showed that on an average about equal numbers of males and females came from each batch. This result occurred in the case of three of the five pairs of flies studied, as the following figures will show:

TABLE I.

No. of Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	375	331	1 : 1
No. 2	309	281	1 : 1
No. 3	324	335	1 : 1

The fourth pair began very early to show a somewhat different sex ratio. Each day twice as many females as males hatched out, so that of the 340 individuals obtained from this pair, 222 were females and 118 were males, making a sex ratio of 2 : 1.

The fifth pair proved to be even more unusual than the fourth in its excess of females for each day two, three and even four times as many females as males would hatch out. The total

number of the offspring of this pair was 439, of which 308 were females and 131 males, making a sex ratio of 2.3 : 1.

When this unusual ratio was first noticed, at the suggestion of Professor Morgan, some of the flies that hatched out were mated, the sisters with their brothers, in order to see whether the peculiar ratio of the parents would be transmitted to any of the children. Sixty-three pairs were made up and kept in good condition, each female being allowed to lay all of her eggs, and the offspring of each carefully separated according to sex and counted. Out of the 63 pairs, 26 showed various high and in some cases unexpected sex ratios, while 37 gave a normal ratio. The results are shown in the following table:

TABLE II.

Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	312	3	104 : 1
No. 2	169	5	34 : 1
No. 3	276	26	10 : 1
No. 4	291	54	5 : 1
No. 5	147	32	4 : 1
No. 6	87	27	3 : 1
No. 7	86	30	3 : 1
No. 8	225	128	2 : 1
No. 9	135	61	2 : 1
No. 10	163	62	2 : 1
No. 11	289	148	2 : 1
No. 12	121	65	2 : 1
No. 13	367	166	2 : 1
No. 14	236	108	2 : 1
No. 15	151	71	2 : 1
No. 16	254	120	2 : 1
No. 17	174	85	2 : 1
No. 18	195	88	2 : 1
No. 19	100	51	2 : 1
No. 20	121	61	2 : 1
No. 21	119	54	2 : 1
No. 22	169	65	2 : 1
No. 23	195	84	2 : 1
No. 24	176	79	2 : 1
No. 25	285	135	2 : 1
No. 26	236	108	2 : 1

One of the first questions that arose was, whether the male or the female was causing the peculiar ratio and to examine this question the following experiments were carried out. The male parent of the best line showing a ratio of 104 : 1 died before I had a chance to breed him with other females, so the father of the

line showing the next best ratio 34 : 1 was used instead. He was mated with five wild females, great care being taken to use only virgin females, with the following results:

TABLE III.

Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	129	85	1 : 1
No. 2	165	173	1 : 1
No. 3	111	103	1 : 1
No. 4	120	110	1 : 1
No. 5	90	91	1 : 1

The father of another good line with a sex ratio of 10 : 1 was also crossed with two virgin wild females and the following results obtained:

TABLE IV.

Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	89	103	1 : 1
No. 2	47	50	1 : 1

Eight males were taken promiscuously from the four lines showing the four best sex ratios and crossed with virgin wild females, with results as follows:

TABLE VI.

Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	220	192	1 : 1
No. 2	147	127	1 : 1
No. 3	167	171	1 : 1
No. 4	103	80	1 : 1
No. 5	134	147	1 : 1
No. 6	178	148	1 : 1
No. 7	112	105	1 : 1
No. 8	115	119	1 : 1

All of these results seem to show conclusively that the abnormal sex ratio is not caused or influenced by the male and it seems probable that it is to the female we must look for a further explanation. This conclusion, therefore, eliminates one of the possible explanations for an excess of females, namely, that the male-producing sperm are non-functional.

Other experiments were carried on at the same time with the female children of the four best lines, to see if the female was causing the unusual ratios. Twelve of the virgin females were crossed with wild males, with these results:

TABLE VIII.

Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	112	43	2+ : 1
No. 2	201	129	1.6 : 1
No. 3	110	108	1 : 1
No. 4	84	38	2 : 1
No. 5	211	103	2 : 1
No. 6	248	121	2 : 1
No. 7	189	191	1 : 1
No. 8	211	138	1.5 : 1
No. 9	57	24	2 : 1
No. 10	152	110	1 : 1
No. 11	147	61	2 : 1
No. 12	156	86	2 : 1

Thus it is shown that it is the female that produces the abnormal sex ratios, just how, is not apparent at present.

One hundred and six of the females from the best line with the 104 : 1 ratio were crossed with wild males in order to see whether any of these children had inherited an abnormal sex ratio from their mother and whether the ratio in any case would be as high as that of the mother. The results are as follows in Table IX.

Thus, although none of the children¹ inherited as high a ratio as their mother showed, at the same time almost all of them inherited a ratio above normal, the majority showing that of their grandmother.

Another generation was obtained by mating 119 of the virgin females taken from the lines showing a 3 : 1 ratio to wild males, in order to see whether the abnormal ratio still persisted and if the 104 : 1 ratio could be recovered again. The general results are as follows:

11 females showed a sex ratio of 3 : 1
 48 females showed a sex ratio of 2 : 1
 60 females showed a sex ratio of 1 : 1

The exact figures are given in Table X.

¹ Eight females died.

TABLE IX.

Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	144	56	(-3) : 1
No. 2	282	99	3 : 1
No. 3	323	112	3 : 1
No. 4	107	35	3 : 1
No. 5	201	67	3 : 1
No. 6	150	49	3 : 1
No. 7	219	75	3 : 1
No. 8	220	76	3 : 1
No. 9	106	39	3 : 1
No. 10	289	102	(-3) : 1
No. 11	277	139	2 : 1
No. 12	177	96	(-2) : 1
No. 13	316	160	2 : 1
No. 14	248	102	2 : 1
No. 15	250	101	2 : 1
No. 16	207	113	2 : 1
No. 17	173	84	2 : 1
No. 18	276	133	2 : 1
No. 19	113	64	(-2) : 1
No. 20	167	79	2 : 1
No. 21	173	79	2 : 1
No. 22	213	111	2 : 1
No. 23	120	69	2 : 1
No. 24	193	93	2 : 1
No. 25	164	72	2 : 1
No. 26	195	96	2 : 1
No. 27	204	102	2 : 1
No. 28	251	98	2 : 1
No. 29	189	72	2 : 1
No. 30	129	67	2 : 1
No. 31	209	85	2 : 1
No. 32	144	59	2 : 1
No. 33	139	57	2 : 1
No. 34	201	76	2 : 1
No. 35	109	44	2 : 1
No. 36	191	78	2 : 1
No. 37	239	101	2 : 1
No. 38	148	65	2 : 1
No. 39	129	73	(-2) : 1
No. 40	228	93	2 : 1
No. 41	317	148	2 : 1
No. 42	235	115	2 : 1
No. 43	252	121	2 : 1
No. 44	138	56	2 : 1
No. 45	154	66	2 : 1
No. 46	87	43	2 : 1
No. 47	118	50	2 : 1
No. 48	214	83	2 : 1
No. 49	181	98	2 : 1
No. 50	205	120	(-2) : 1
No. 51	254	104	2 : 1
No. 52	156	85	(-2) : 1
No. 53	211	85	2 : 1
No. 54	175	89	2 : 1
No. 55	178	70	2 : 1
No. 56	145	72	2 : 1
No. 57	123	48	2 : 1
No. 58	191	94	2 : 1
No. 59	187	66	2 : 1

TABLE IX—*Continued.*

Pair.	No. of Females.	No. of Males.	Ratio.
No. 60	167	64	2 : 1
No. 61	117	57	2 : 1
No. 62	130	63	2 : 1
No. 63	322	140	2 : 1
No. 64	129	62	2 : 1
No. 65	229	111	2 : 1
No. 66	300	123	2 : 1
No. 67	269	143	(-2) : 1
No. 68	286	133	2 : 1
No. 69	284	126	2 : 1
No. 70	240	124	2 : 1
No. 71	92	40	2 : 1
No. 72	273	118	2 : 1
No. 73	197	98	2 : 1
No. 74	70	35	2 : 1
No. 75	243	103	2 : 1
No. 76	168	63	2 : 1
No. 77	116	56	2 : 1
No. 78	210	102	2 : 1
No. 79	243	110	2 : 1
No. 80	237	108	2 : 1
No. 81	149	65	2 : 1
No. 82	124	56	2 : 1
No. 83	82	41	2 : 1
No. 84	64	28	2 : 1
No. 85	133	64	2 : 1
No. 86	122	57	2 : 1
No. 87	96	45	2 : 1
No. 88	97	54	2 : 1
No. 89	56	25	2 : 1
No. 90	35	17	2 : 1
No. 91	49	26	2 : 1
No. 92	165	104	(1+) : 1
No. 93	193	118	(1+) : 1
No. 94	210	216	1 : 1
No. 95	133	85	(1+) : 1
No. 96	150	140	1 : 1
No. 97	178	107	(1+) : 1
No. 98	71	44	1 : 1

TABLE X.

Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	143	49	3 : 1
No. 2	164	59	3 : 1
No. 3	124	43	3 : 1
No. 4	149	50	3 : 1
No. 5	118	39	3 : 1
No. 6	139	49	3 : 1
No. 7	143	45	3 : 1
No. 8	144	52	3 : 1
No. 9	111	39	3 : 1
No. 10	87	30	3 : 1
No. 11	91	33	3 : 1
No. 12	140	63	2 : 1
No. 13	36	17	2 : 1
No. 14	140	75	2 : 1
No. 15	141	52	2(+) : 1
No. 16	83	40	2 : 1
No. 17	66	36	2 : 1
No. 18	35	19	2 : 1
No. 19	150	68	2 : 1
No. 20	95	50	2 : 1
No. 21	176	70	2 : 1
No. 22	182	90	2 : 1
No. 23	50	23	2 : 1
No. 24	34	16	2 : 1
No. 25	83	44	2 : 1
No. 26	119	51	2 : 1
No. 27	110	40	2(+) : 1
No. 28	96	50	2 : 1
No. 29	133	74	2 : 1
No. 30	146	76	2 : 1
No. 31	51	23	2 : 1
No. 32	138	53	2 : 1
No. 33	147	71	2 : 1
No. 34	126	62	2 : 1
No. 35	153	79	2 : 1
No. 36	104	46	2 : 1
No. 37	103	44	2 : 1
No. 38	79	42	2 : 1
No. 39	147	62	2 : 1
No. 40	79	40	2 : 1
No. 41	162	77	2 : 1
No. 42	92	45	2 : 1
No. 43	98	51	2 : 1
No. 44	122	60	2 : 1
No. 45	96	52	2 : 1
No. 46	118	46	2 : 1
No. 47	133	55	2 : 1
No. 48	68	33	2 : 1
No. 49	72	37	2 : 1
No. 50	76	34	2 : 1
No. 51	105	55	2 : 1
No. 52	173	89	2 : 1
No. 53	78	40	2 : 1
No. 54	124	46	2(+) : 1
No. 55	106	50	2 : 1
No. 56	89	39	2 : 1
No. 57	139	61	2 : 1
No. 58	102	50	2 : 1
No. 59	90	50	2 : 1
No. 60	117	104	1 : 1

TABLE X—*Continued.*

Pair.	No. of Females.	No. of Males.	Ratio.
No. 61	75	55	1 : 1
No. 62	46	56	1 : 1
No. 63	25	25	1 : 1
No. 64	53	55	1 : 1
No. 65	27	36	1 : 1
No. 66	91	78	1 : 1
No. 67	60	59	1 : 1
No. 68	118	86	1 : 1
No. 69	110	66	1(—) : 1
No. 70	61	51	1 : 1
No. 71	44	53	1 : 1
No. 72	114	100	1 : 1
No. 73	103	64	1(—) : 1
No. 74	122	85	1 : 1
No. 75	82	57	1 : 1
No. 76	122	122	1 : 1
No. 77	109	88	1 : 1
No. 78	142	131	1 : 1
No. 79	128	132	1 : 1
No. 80	133	129	1 : 1
No. 81	97	99	1 : 1
No. 82	114	96	1 : 1
No. 83	97	77	1 : 1
No. 84	111	98	1 : 1
No. 85	102	107	1 : 1
No. 86	55	46	1 : 1
No. 87	93	87	1 : 1
No. 88	92	63	1 : 1
No. 89	98	90	1 : 1
No. 90	118	98	1 : 1
No. 91	136	141	1 : 1
No. 92	109	96	1 : 1
No. 93	118	109	1 : 1
No. 94	105	85	1 : 1
No. 95	136	104	1 : 1
No. 96	121	101	1 : 1
No. 97	133	159	1 : 1
No. 98	164	94	1 : 1
No. 99	72	77	1 : 1
No. 100	84	81	1 : 1
No. 101	98	60	1(—) : 1
No. 102	93	55	1(—) : 1
No. 103	106	106	1 : 1
No. 104	94	73	1 : 1
No. 105	80	68	1 : 1
No. 106	66	54	1 : 1
No. 107	81	85	1 : 1
No. 108	71	40	1(—) : 1
No. 109	82	80	1 : 1
No. 110	108	89	1 : 1
No. 111	91	49	1(—) : 1
No. 112	102	100	1 : 1
No. 113	93	106	1 : 1
No. 114	45	67	1 : 1
No. 115	101	79	1 : 1
No. 116	93	92	1 : 1
No. 117	88	104	1 : 1
No. 118	84	85	1 : 1
No. 119	67	70	1 : 1

Two other generations have been carried through with these results:

From 49 females mated

1 showed a ratio of 4 : 1

3 showed a ratio of 3 : 1

12 showed a ratio of 2 : 1

33 showed a ratio of 1 : 1

The exact figures are:

TABLE XI.

Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	92	22	4 : 1
No. 2	97	33	3 : 1
No. 3	62	16	3 : 1
No. 4	139	50	3 : 1
No. 5	105	48	2 : 1
No. 6	95	41	2 : 1
No. 7	147	66	2+ : 1
No. 8	148	59	2+ : 1
No. 9	66	33	2 : 1
No. 10	46	21	2 : 1
No. 11	174	65	2+ : 1
No. 12	76	38	2 : 1
No. 13	172	79	2+ : 1
No. 14	74	39	2 : 1
No. 15	110	54	2 : 1
No. 16	79	41	2 : 1
No. 17	117	78	1+ : 1
No. 18	138	130	1 : 1
No. 19	96	91	1 : 1
No. 20	110	98	1 : 1
No. 21	64	60	1 : 1
No. 22	152	87	1+ : 1
No. 23	48	35	1 : 1
No. 24	162	165	1 : 1
No. 25	180	138	1+ : 1
No. 26	73	79	1 : 1
No. 27	91	89	1 : 1
No. 28	67	68	1 : 1
No. 29	117	78	1+ : 1
No. 30	148	152	1 : 1
No. 31	155	110	1+ : 1
No. 32	52	39	1 : 1
No. 33	62	46	1+ : 1
No. 34	69	44	1+ : 1
No. 35	135	114	1 : 1
No. 36	126	95	1 : 1
No. 37	78	45	1+ : 1
No. 38	100	71	1 : 1
No. 39	64	70	1 : 1
No. 40	70	64	1 : 1
No. 41	46	59	1 : 1
No. 42	136	95	1+ : 1
No. 43	63	40	1+ : 1
No. 44	61	67	1 : 1
No. 45	74	73	1 : 1
No. 46	107	76	1 : 1
No. 47	37	38	1 : 1
No. 48	96	77	1 : 1
No. 49	91	107	1 : 1

From 25 females mated with wild males

1 showed a ratio of 3 : 1

10 showed a ratio of 2 : 1

14 showed a ratio of 1 : 1

The exact figures are:

TABLE XII.

Pair.	No. of Females.	No. of Males.	Ratio.
No. 1	91	31	3 : 1
No. 2	69	33	2 : 1
No. 3	123	51	2 : 1
No. 4	90	47	2 : 1
No. 5	116	59	2 : 1
No. 6	104	41	2+ : 1
No. 7	90	45	2 : 1
No. 8	59	24	2 : 1
No. 9	58	26	2 : 1
No. 10	60	25	2 : 1
No. 11	53	27	2 : 1
No. 12	40	46	1 : 1
No. 13	39	57	1 : 1
No. 14	86	57	1 : 1
No. 15	96	87	1 : 1
No. 16	70	61	1 : 1
No. 17	51	48	1 : 1
No. 18	69	58	1 : 1
No. 19	59	71	1 : 1
No. 20	121	78	1+ : 1
No. 21	59	69	1 : 1
No. 22	68	57	1 : 1
No. 23	52	64	1 : 1
No. 24	94	83	1 : 1
No. 25	56	43	1 : 1

The results of these last generations seem to indicate that the unusual sex ratio is gradually disappearing, to judge from the number of individuals that inherit it, but whether it can be maintained by breeding from certain strains remains to be determined.